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Prototype of Monitoring and Controlling System on Gondola Cage Security Based Android Application

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***Abstract*— Gondola is one of the facilities used in high-rise buildings that are used to access the outside of the building. Gondola has a maximum load limit that is safe to transport it. Gondola is also often damaged in the cage caused by collisions on the side of the building. Until now, the gondola control still uses buttons which also often experience problems. This study aims to provide monitoring of the cage load and provide information about the distance of the cage to surrounding objects. Gondola control through an android application also includes this research in order to provide an alternative if the buttons on the gondola control experience problems. The short-term goal of this research is to carry out an innovation in the gondola field by conducting experiments through prototypes. The medium term goal is to apply the results of this research into a gondola. The results of this study control and monitoring can function properly even though the results produced are not yet accurate due to the imperfect quality of components, materials and assembly.**

Keywords—android, gondola, monitoring and controlling system.

I. Introduction

The number of buildings in urban areas around the world indicates that civilization is moving forward. These tall buildings certainly require maintenance to stay strong and look attractive to anyone who sees them. The maintenance and cleaning of high-rise buildings does not escape the contribution of the workers. A building must have parts that are difficult to reach when they want to carry out maintenance. A tool or facility that is almost owned by the majority of buildings and other high-rise buildings is a gondola. Suspended Working Platform or gondola is a supporting tool or tool that is usually used by workers, operators, or cleaners who work outside buildings or high-rise buildings. It's no wonder that in the end the device is called a gondola for high-rise building [1], [2]. Gondola is a tool or facility that is very useful if a building wants to always be in good condition both on the walls and on the glass. In offices and apartments that have high-rise buildings, of course, to clean the glass, they have to face a high risk, because they have to be at a height. The use of gondolas in cleaning glass or repairing the outer walls of high-rise buildings by workers is still very risky, although the gondola used is classified as safe, the activity of using a gondola is still capable of threatening the lives of its workers [3]–[5].

Along with the advancement of science and technology, especially electronic devices, they have developed very rapidly and are considered useful to facilitate a job. Innovations and many new discoveries in developing modern and more sophisticated equipment always occur in all fields of work including the gondola field [6] .One way to determine the condition of the gondola is to use a monitoring and controlling system. This will make it easier to monitor the condition of the gondola by using sensors that we can monitor remotely [7]–[11]. In addition to the monitoring system, it has to implement a controlling system to take action from the input that comes from the sensor [12]–[14].

Like a tool, the gondola must have a proper and unfit condition. Appropriate when all components and machines are in normal condition and not feasible if there is a damage to the component parts or electrical control. The cage or basket is part of the components of a gondola. The capacity that can be transported must have been determined when it was first fabricated and assembled by the manufacturer. The lack of information that is known by gondola workers about the load that is on the cage when the gondola operates makes some components do not have a long life. In the field of electronics the Load Cell weight sensor is integrated with the HX711 as a weighbridge. With this integration several advantages are obtained, namely getting a warning when the gondola cage is overloaded [15]. The condition of the cage is often found in a former condition due to the negligence of workers in moving the gondola. the lack of attention of workers in operating the gondola is a major factor in the damage to the gondola cage itself. With the role of information technology which is currently growing rapidly and with the problems with the gondola, the authors make a tool to help gondola workers by providing information on the distance of foreign objects to the gondola cage. This technology is a form of participation for gondola workers to reduce accidents while doing work or damage to the gondola cage [16] . In addition to the cage, the control conditions on the gondola electricity also often experience problems. Both in terms of control components such as buttons. One of the applications in smartphones that can be connected to Arduino is controlling the gondola, such as the up and down controller in the gondola cage [15]. An alternative control and media providing information about the load on the cage to the gondola user is very much needed as a form of gondola maintenance and to avoid things that are not desirable.

II. Methods

A. Block Diagram System

In the design and manufacture of the tool refer to the block diagram the system used is as shown in Figure 1.

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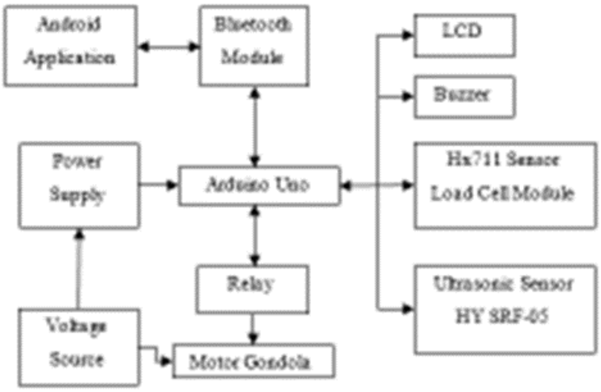

Fig. 1. Block diagram system

The system designed consists of the Arduino Uno Microcontroller. In Figure 3.2 Arduino serves as the brain of several components that will be made. For the input current, Arduino Uno gets the current supplied by the Power Supply with an output voltage of 12VDC. The Power Supply will get a source through the available electricity of 220VAC which will be Step Down and converted to 12V DC voltage. The ultrasonic sensor will measure the distance between the cage and surrounding objects to prevent collisions with the cage and foreign objects. Then there is a Load Cell Sensor which will read the load value into resistance which will be converted into an electrical signal. Then the electrical signal will be amplified by the HX711 module and sent to the Arduino Uno to be displayed on the LCD screen. The buzzer will work when the load and distance that the Arduino Uno reads get a predetermined value. In Figure 3.2 there is also a 4 Channel Relay Module which functions as a switch to turn on the DC Motor and buzzer on the Gondola. On/Off control on the Relay will be carried out on the Android application that is connected to the Arduino Uno via the HC-05 Bluetooth Module. For the value of the load and distance itself, apart from being seen on the LCD, it can also be seen on the Android Application display. So that when using Emergency Control the user can also get information about the readable load value and cage distance.

B. Flowchart System

The flow diagram of this system is divided into two parts,namely the diagram on Gondola Control and the diagram on monitoring the load is depicted in Figure 2 and Figure 3.

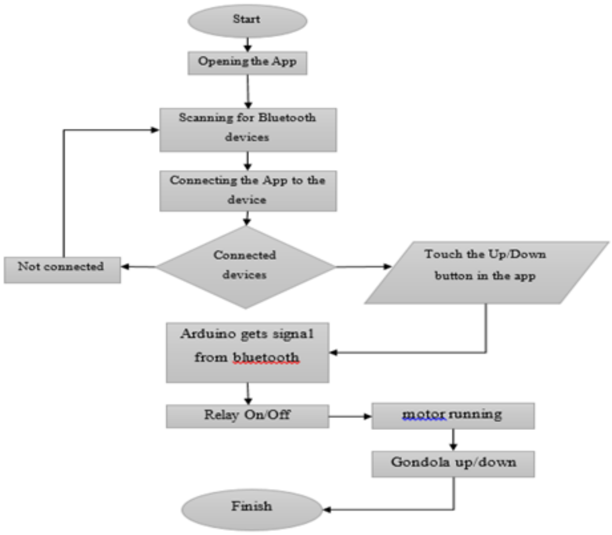

Fig. 2. System tools and applications flowchart

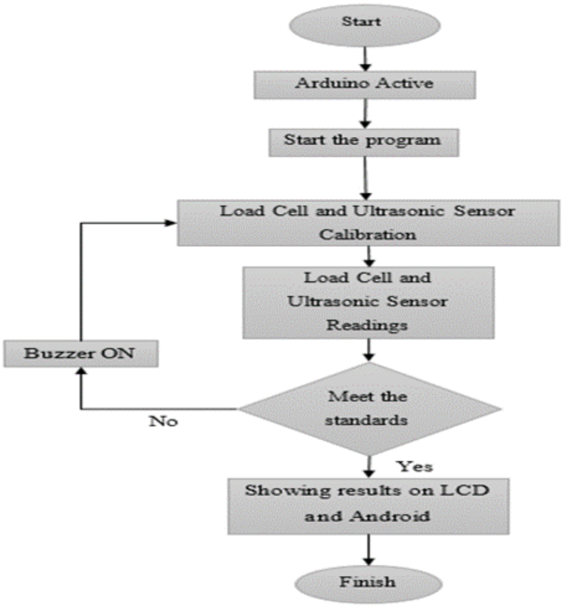

Fig. 3. Load and distance monitoring system flowchart

C. Authors and Affiliations

This project only uses a Gondola cage prototype as a test tool. For the size of this prototype using a scale of 1:10 from the original size is depicted in Figure 4.

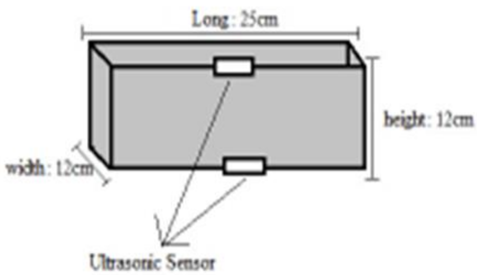

Fig. 4. Gondola cage prototype design

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III. Results and Discussion

A. MIT App Innventor 2 Application Design Results

After designing the application on the MIT App Inventor 2 website, the results of the application design is depicted on Figure 5. In Figure 5 there is a Bluetooth logo display that serves as a medium for selecting Bluetooth devices to be connected to the application. Then there are two display buttons where the button will be used as a gondola control. At the bottom there is a table containing the load, top distance, and bottom distance where in this section will bring up the sensor reading value on the device that is connected to the application. This test is intended to ensure that the monitoring table in the android application is functioning properly. The results in the monitoring table in the application must match the results shown on the LCD screen on the tool.

Fig. 5. Result on android application and LCD screen

B. Tool Assembly Result

In the previous chapter, the expected circuit drawing was made, then the components that had been designed were assembled. The results of the tool assembly can be seen in Figure 6.

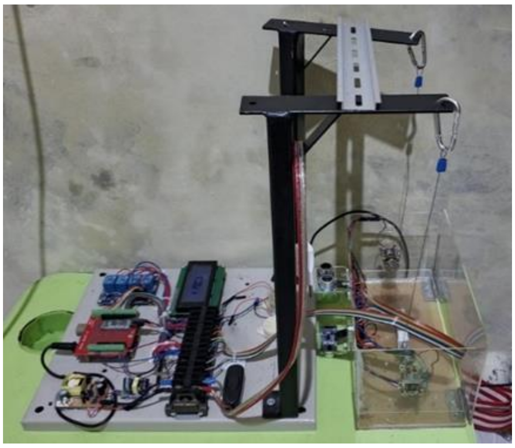

Fig. 6. Prototype system

C. Load Cell Sensor Test

The Load Cell sensor used in this system to provide the information about the weight of objects that are in the gondola cage prototype. When the Load Cell sensor provides data about the weight of objects in the gondola cage, this information can be known by looking at the android application or the LCD screen contained in the tool is depicted in Figure 7. This test aims to find out how well the load cell sensor works. In this test there are also results of measuring the weight of objects with a Load Cell sensor which will be compared with commercial scales. Table 1 showed the measuring results of the weight of objects using the Load Cell sensor with the scales. From the results in the table above, it is known that the results of weight measurements on the Load Cell sensor are still different from the results found on commercial scales. The maximum difference obtained is 6 grams and the error percentage is 5.33%.

Fig. 7. Load sensor testing

D. Ultrasonic Sensor Test

The ultrasonic sensor used in this system to measure of the distance between the cage and the objects around it. The ultrasonic sensor aims to provide a signal to the microcontroller which will then be processed and displayed on the LCD screen or android application, so that the value of the distance between the cage and objects around it can be known is depicted in Figure 8. This ultrasonic sensor test aims to find out how accurate the results given by the sensor are compared to existing measuring instruments. Here the author uses a ruler as a measuring tool used to measure distances in centimeters (cm). From Table 2 and Table 3, it can be seen that the measurement results between the ultrasonic sensor and the ruler are still different with a maximum difference of 2.2 cm and an error percentage of 8.08%.

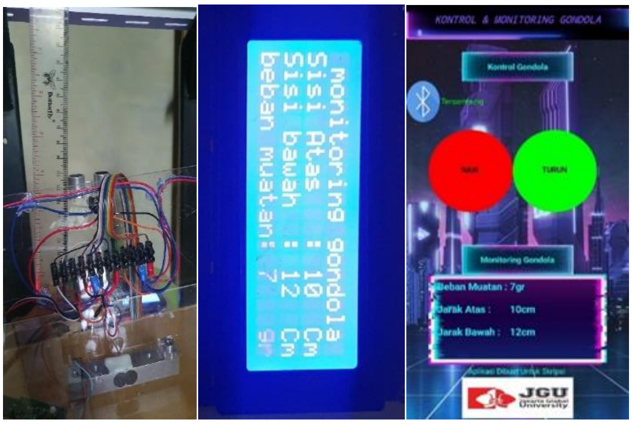

Fig. 8. Ultrasonic sensor testing

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TABLE 1 LOAD SENSOR DATA RESULT

No	Item Name	Scale Result (grams)	Load Cell Sensor Results (grams)	Error (grams)	Percentage Error (grams)
1	Small Screwdriver	21	20	1	4.76
2	Big Screwdriver	91	91	0	0.00
3	Board	75	79	4	5.33
4	Screwdriver Box	98	100	2	2.04
5	Can	122	128	6	4.91

TABLE 2 ULTRASONIC SENSOR 1 (TOP BUILDING AND CAGE) DATA RESULT

No	Number of Trials	Ruler Result (cm)	Ultrasonic Sensor Results 1 (cm)	Error (cm)	Percentage Error (cm)
1	Trial 1	5.5	5	0.5	9.09
2	Trial 2	10.2	10	0.2	1.96
3	Trial 3	15.8	15	0.8	5.06
4	Trial 4	23.2	23	0.2	0.86
5	Trial 5	26.5	25	1.5	5.66

TABLE 3 ULTRASONIC SENSOR 2 (UNDER BUILDING AND CAGE) DATA RESULT

No	Number of Trials	Ruler Result (cm)	Ultrasonic Sensor Results 2 (cm)	Error (cm)	Percentage Error (cm)
1	Trial 1	9.6	9	0.4	4.16
2	Trial 2	12.5	12	0.5	4.00
3	Trial 3	18.7	19	0.3	1.60
4	Trial 4	25.5	24	1.5	5.88
5	Trial 5	27.2	25	2.2	8.08

E. Integration Testing

Gondola operational testing aims to determine the results of the tools that have been made is depicted in Figure 9. This test serves to determine whether the tool can work properly or not. For the height used is a shelf with a height of 120 cm with a pole of 35 cm. With a scale of 1:10 this cabinet will be used as a simulation of a building with a height of 12 m and a pillar of 3.5 m. From the above test, it can be seen that the results of each sensor have inaccurate values. This unstable value can be caused by several factors such as: poor components, inappropriate assembly, inadequate power supply, ambient conditions when testing and lack of accuracy of testers during testing. However, from the results above, it can be seen that the tool can be operated and functions properly. The alarm also works as expected. If the load and distance are not up to standard, the alarm sounds properly. The integration testing data is depicted on Table 4.

Fig. 9. Integration testing

TABLE 4 INTEGRATION TESTING DATA

No	Height (cm)	Ultrasonic Sensor Results bottom 2 sides (cm)	Ultrasonic Sensor Results 1 side up (cm)	Load Cell Sensor Result (grams)	Load Alarm	Cage Distance Alarm
1	0	2	81	126	OFF	ON
2	10	9	130	242	ON	OFF
3	30	29	107	117	OFF	OFF
4	70	63	72	141	OFF	OFF
5	120	84	23	139	OFF	OFF

IV. CONCLUSION

The prototype of monitoring and controlling system on gondola cage system based android application have been implemented and tested. This system used to support safety in carrying out work in the gondola field, additional monitoring tools can be carried out regarding the load and distance in the gondola cage. This system can make it easier for workers to determine the load and distance in the gondola cage. This system can be alternative way to control the gondola system because it can support with the cellphone while the control panel are broken.

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